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(54) [Title of the Invention]

ACTIVE MATRIX LIQUID CRYSTAL DISPLAY DEVICE

(57) [Abstract]

[Purpose]

The purpose of the present invention is to reduce short-circuit defects and disconnection failures in an extraction wiring portion that connects a signal line or a scanning line of an element array portion for a TFT substrate to a connection pad.

[Constitution]

A signal line connected to a source or drain in an element array portion is formed

using a second layer wiring 4, while a scanning line connected to a gate is formed using a first layer wiring 2. A connection pad, which is connected to an external circuit, is formed using the second layer wiring. An extraction wiring for connecting the signal line in the element array portion to the connection pad is formed by alternately disposing an extraction wiring formed using the first layer wiring 2 as shown in A and another one formed using the second layer wiring 4 as shown in B. Similarly, a scanning line extraction wiring is formed by alternately disposing an extraction wiring formed using the first layer wiring 2 as shown in C and another one formed using the second layer wiring 4 as shown in D.

[Scope of Claim]

[Claim 1] An active matrix liquid crystal display device comprising:

a plurality of first wirings which are formed using a first layer wiring and are parallel with each another;

a plurality of second wirings which are formed using a second layer wiring and extend in a direction orthogonal to the plurality of first wirings;

a connection pad that is connected to an external circuit; and

extraction wirings connecting between the plurality of first wirings and the plurality of second wirings and the connection pad,

wherein at least one of the extraction wiring connected to the plurality of first wirings and the extraction wiring connected to the plurality of second wirings is formed using the first layer wiring or the second layer wiring and formed in a layer of wiring different from an adjacent extraction wiring.

[Detailed Description of the Invention]

[0001]

[Field of the Industrial Application] The present invention relates to an active matrix liquid crystal display device, in particular, a structure of a metal wiring in an extraction wiring portion of a pixel electrode substrate.

[0002]

[Prior Art] An active matrix liquid crystal display device includes a pixel electrode substrate over which an element such as a TFT is formed, and a common electrode substrate over which a color filter is formed, if required. A scanning line and a signal line that intersects with the signal line extend in an element array portion of the pixel electrode substrate. Each wiring is connected through an extraction wiring to a connection pad that is provided in the periphery of the substrate.

[0003] FIG. 3 is a plain view showing a connection state of an extraction wiring portion. In FIG. 3, reference numeral 11 denotes a wiring of an element array portion that is a scanning line or a signal line; 12, a wiring connection portion; 13, an extraction wiring; and 14, a connection pad connecting to a driver circuit that is provided at an external portion.

[0004] Various kinds of conventional structures in the vicinity of the extraction wiring portion are shown in FIG. 4. These structures are examples in the case of using an inverted staggered TFT, wherein a first layer wiring is used as a scanning line connected to a gate electrode, and a second layer wiring is used as a signal line connected to a source or drain electrode. Generally, the connection pad is formed using the second layer wiring.

[0005] In FIG. 4, reference numeral 1 represents a glass substrate; 2, a first layer wiring; 3, an insulating film that is formed simultaneously with a gate insulating film (hereinafter, referred to as the gate insulating film for the sake of convenience); and 4, a second layer wiring.

[0006] As shown in the first conventional example in FIG. 4(a), with respect to the signal line, the signal line in the element array portion, the extraction wiring, and the connection pad are all formed by the second layer wiring. With respect to the scanning line, the scanning line wiring in the element array portion and the extraction wiring are formed of the first layer wiring while the connection pad is formed of the second layer wiring.

[0007] FIG. 4(b) shows the second conventional example that is improved such that disconnection failures at the connection wiring portion in the first conventional example are eliminated. In the second conventional example, the connection wiring portion has a

two layered structure of the first layer wiring 2 and the second wiring layer 4.

[0008] FIG. 4(c) shows the third conventional example in which the extraction wiring is formed by using the first layer wiring that is formed and etched relatively stably so that disconnection failures and short-circuit defects are eliminated.

[0009]

[Problem to be Solved by the Invention] The above-described conventional structures of the extraction wirings have a drawback in which disconnection failures and short-circuit defects are easily caused according to reasons as follows. Since the extraction wirings are formed at a slant as schematically shown in FIG. 3, a minimum gap between the wirings is narrowed, and the length of the extraction wirings is relatively longer as several mm to several tens mm. Since base configurations of the extraction wiring portion and the element array portion are different with each other, when the wirings are patterned especially by dry etching, etching rate is varied in each region so that a terminal point of the etching is difficultly set.

[0010] Concretely, in the first conventional example as shown in FIG. 4(a), the disconnection failures and the short-circuit defects are easily caused in both the signal line and the scanning line. In the second conventional example, the short-circuit defects are increased, though the disconnection failures are reduced. With respect to the third conventional example as shown in FIG. 4(c), it is substantially equivalent to the first conventional example, and therefore, defects and failures are caused as well as the first conventional example.

[0011]

[Means for Solving the Problem] In a pixel electrode substrate of the active matrix liquid crystal display device according to the invention, extraction wirings for connecting wirings in an element array portion and connections pad are formed by alternately using a first layer wiring and a second layer wiring.

[0012]

[Embodiments] The embodiments of the present invention will be described below with reference to the drawings. FIG. 1 is cross sectional views showing the first embodiment

of the invention. The first embodiment relates to an example of using an inverted staggered TFT.

[0013] In a connection method as shown in FIG. 1(a), a signal line of an element array portion is connected to a connection pad through an extraction wiring that uses a first layer wiring 2. In a connection method as shown in FIG. 1(b), the signal line of the element array portion is connected to the connection pad through the extraction wiring that uses the second layer wiring 4. In the embodiment, the extraction wirings as shown in FIGS. 1(a) and 1(b) are disposed alternately.

[0014] Meanwhile, as shown in FIG. 1(c), a scanning line of an element array portion that is formed by the first layer wiring 2 is connected to the connection pad through the extraction wiring of the first layer wiring 2. Or, as shown in FIG. 1(d), the scanning line is connected to the connection pad through the extraction wiring of the second layer wiring 4. Similarly, the extraction wirings as shown in FIGS. 1(c) and 1(d) are disposed alternatively in the scanning line.

[0015] In regard to the signal line and the scanning line, the extraction wiring is formed by alternatively using the first layer wiring and the second layer wiring and an adjacent extraction wiring exists inside of a different layer, thereby eliminating the short-circuit defects significantly. Also, in the same surface, the pitch between the extraction wirings is twice as large as that of the conventional examples so that the width of the wirings can be set to be wide sufficiently, thereby reducing the disconnection failures drastically.

[0016] The respective wirings of the embodiment are formed while forming the element array portion, and hence, the number of steps is not increased according to the invention.

[0017] FIG. 2 is cross sectional views in the vicinity of the extraction wiring potion according to the second embodiment of the invention. The present embodiment relates to the case of using a staggered TFT. In the staggered TFT, a signal line that is connected to a source or drain electrode is formed using a first layer wiring, whereas a scanning line that is connected to a gate electrode is formed using a second layer wiring.

[0018] The present embodiment is implemented by changing the first embodiment according to the staggered TFT. As well as the first embodiment, with respect to the

signal line, an extraction wiring (as shown in FIG. 2(a)) formed using the first layer wiring 2 and an extraction wiring (as shown in FIG. 2(b)) formed using the second layer wiring 4 are arranged alternately. With respect to the scanning line, an extraction wiring (as shown in FIG. 2(c)) formed using the first layer wiring 2 and an extraction wiring (as shown in FIG. 2(d)) formed using the second layer wiring 4 are arranged alternately.

[0019] In the above embodiments, the signal line and the scanning line are formed by alternately disposing the extraction wirings, respectively. Generally, since a larger number of wirings are required as compared with the scanning line, and therefore, only the signal line may be formed by alternately disposing the extraction wirings while the scanning line may be formed to have a conventional structure. Of course, when the defects and failures are easily caused in the scanning line, only the scanning line can be formed by alternately disposing the extraction wirings. The present invention is applicable not only to a liquid crystal display device using a TFT, but also to a liquid crystal display device using another switching element.

[0020]

[Effect of the Invention] As set forth above, in a pixel electrode substrate of a liquid crystal display device of the invention, an extraction wiring that connects between a signal line or a scanning line and a connection pad is formed by alternately using a first layer wiring and a second layer wiring. According to the invention, adjacent extraction wirings do not exist in an identical layer, thereby reducing the short-circuit defects significantly.

[0021] In addition, the pitch between the extraction wirings is twice as large as that of the conventional examples so that the width of the wirings can be sufficiently set to be within the range of causing no short-circuit defects. As a consequence, the disconnection failures of the extraction wirings can be drastically reduced according to the invention.

[Brief Description of the Drawings]

FIG. 1 is cross sectional views showing a pixel electrode substrate according to the first embodiment of the invention;

FIG. 2 is cross sectional views showing a pixel electrode substrate according to

the second embodiment of the invention;

FIG. 3 is a plain view schematically showing a pattern in the vicinity of an extraction wiring portion for a pixel electrode substrate; and

FIG. 4 is cross sectional views showing conventional examples of a pixel electrode substrate.

[Description of Reference Symbols]

1: glass substrate

2: first layer wiring

3: gate insulating film

4: second layer wiring